

A Survey of the Nematodes Attacking Crops in Thailand

II. Genus *Tylenchorhynchus* COBB, 1913*

Takayuki MIZUKUBO**, Yukio TOIDA*** and Somkuan KEEREewan****

Five species of the genus *Tylenchorhynchus* found from crop fields in Thailand are measured, described and illustrated as follows: *T. annulatus*, *T. curvus*, *T. divittatus*, *T. leviterminalis* and *T. maqbooli* nom. nov. (syn. *T. solani* (MAQBOOL, 1982) sensu FORTUNER & LUC, 1987). *Tylenchorhynchus maqbooli* and *T. leviterminalis* are the first record for the species in Thailand. *Jpn. J. Nematol.* **23**(1): 19-27 (1993).

Key words: *Tylenchorhynchus*, survey, Thailand.

This is the second part of the serial report on the plant parasitic nematodes in Thailand, dealing with *Tylenchorhynchus* spp. Seventeen species of the genus in Thailand have been reported by the Thai nematologists as follows:

- T. acutus* ALLEN, 1955 (3, 4)
- T. bifasciatus* ANDRÁSSY, 1961 (2, 3, 4, 8)
- (= *Trichotylenchus bifasciatus* (ANDRÁSSY, 1961) FORTUNER & LUC, 1987 (5))
- T. brassicae* SIDDIQI, 1961 (3)
- T. clavicaudatus* SEINHORST, 1963 (4)
- T. crassicaudatus* WILLIAMS, 1960 (2, 3, 15, 16),
- T. curvus* WILLIAMS, 1960 (15)
- T. dactylurus* DAS, 1960 (4)
- T. delhiensis* CHAWLA et al., 1968 (3)
- T. divittatus* SIDDIQI, 1961 (16)
- T. dubius* (BÜTSCHLI, 1873) FILIPJEV, 1936 (3)
- T. elegans* SIDDIQI, 1961 (3)
- T. latus* ALLEN, 1955 (3)
- T. lineatus* ALLEN, 1955 (3)
- (= *Merlinius lineatus* (ALLEN, 1955) SIDDIQI, 1970)
- T. martini* FIELDING, 1956 (3, 4, 15, 16)
- (= *T. annulatus* (CASSIDY, 1930) GOLDEN, 1971)
- T. nudus* ALLEN, 1955 (2)

*Cooperative investigation by the Tropical Agriculture Research Center (TARC), Japan and Department of Agriculture (DOA), Thailand.

**Laboratory of Nematology and Soil Zoology, Division of Microbiology, National Institute of Agro-Environmental Sciences, Kannondai 3-1-1, Tsukuba, Ibaraki, 305, Japan.

***Research Division 1, Tropical Agricultural Research Center, Ohwashi 1-2, Tsukuba, Ibaraki, 305, Japan.

****Nematology Section, Division of Plant Pathology, Department of Agriculture, Bangkok, Bangkok 10900, Thailand.

T. thailandicus BOONDUANG & RATANAPRAPA, 1977 (2, 3)

T. triglyphus SEINHORST, 1963 (3, 4, 15).

Tylenchorhynchus thailandicus has 3 lateral field incisures, offset lip region with 5 annules, conoid tail with narrowly rounded terminus and straight gubernaculum, and was compared with *T. bifasciatus* ANDRÁSSY, 1961 and *T. palustris* MERNY and GERMANI, 1968. BOONDUANG & PLIANSINCHAI (2) transferred the species to the genus *Uliginotylenchus* SIDDIQI, 1971. The latter genus, however, has been synonymized with the genus *Trichotylenchus* WHITEHEAD, 1960 (5). Despite that, *T. thailandicus* does not fit into the emended diagnosis of the genus *Trichotylenchus* (5) in the lip shape (offset vs. continuous), tail shape (conoid, with narrowly rounded end vs. cylindroid, with a broadly rounded or clavate end), and gubernaculum (straight vs. bent). The well developed velum of spicules, which is diagnostic for the *Trichotylenchus*, had not been described for this species. Hence, we reserve the species under the original generic status as *Tylenchorhynchus thailandicus*. Other 2 species in the above list have been transferred to the genera *Trichotylenchus* and *Merlinius*, hence, 15 species are recorded in the genus *Tylenchorhynchus* from Thailand. Identifications of the species presently detected are made mainly using diagnostic data provided by HOOPER (7), TARJAN (21) and MAHAJAN (11), and the results are confirmed by checking with the original descriptions of the species.

Methods of the preparation and the research sites were described in the first part of this serial report (14).

RESULTS

Tylenchorhynchus annulatus (CASSIDY, 1932) GOLDEN, 1971

(Fig. 1 A-F)

Measurements (females): Col. no. 5 (n=2): L=592-697 μm ; a=31.7-34.5; b=4.6-4.7; c=14.0-14.8; c'=3.4-3.7; V=56.0-57.1%; MB=44.6-45.6%; spear=17-18 μm ; m=50.0-52.4%; dorsal gland orifice from spear knob base (DGO)=2.0-2.2 μm ; O=11.9-12.2; excretory pore from anterior body end (EXPORE)=105-106 μm ; esophagus=129-149 μm ; VL=331-398 μm ; vulva-anus=219-252 μm ; tail=42-47 μm ; tail/V-a=18.7-19.3%; annule width at mid-body (annule)=1.5-1.9 μm .

Col. no. 40 (n=9): L=653-769 μm (709 \pm 40.5: mean \pm S.D.); a=25.2-30.0 (28.4 \pm 1.85); b=4.4-5.3 (4.8 \pm 0.28); c=14.2-16.9 (15.5 \pm 0.78); c'=2.5-3.3 (2.8 \pm 0.26); V=55.6-58.3% (57.1 \pm 0.57); MB=44.2-49.8% (46.8 \pm 1.73); spear=17.5-20.5 μm (19.1 \pm 1.01); m=47.5-54.5% (49.4 \pm 2.06); DGO=3.3-4.0 μm (3.5 \pm 0.35); O=14.8-20.0% (17.5 \pm 1.9); EXPORE=110-120 μm (115 \pm 3.7); esophagus=137-164 μm (148 \pm 7.5); VL=374-438 μm (405 \pm 21.4); vulva-anus=238-291 μm (259 \pm 17.7); tail=42-52 μm (46 \pm 3.7); tail/V-a=16.2-19.8% (17.7 \pm 1.09); annule=1.5-2.2 μm (1.8 \pm 0.20).

Col. no. 68 (n=11): L=614-791 μm (678 \pm 52.3); a=23.0-32.4 (28.3 \pm 2.38); b=4.6-5.1 (4.9 \pm 0.17); c=12.5-15.6 (14.0 \pm 0.76); c'=2.8-4.0 (3.2 \pm 0.31); V=54.6-56.6% (55.6 \pm 0.75); MB=44.8-49.5% (46.9 \pm 1.33); spear=17.5-20 μm (18.7 \pm 0.65); m=49.1-52.3% (50.8 \pm 1.02); DGO=2.0-3.0 μm (2.4 \pm 0.3); O=10.6-15.0% (12.7 \pm 1.4); EXPORE=101-121 μm (110 \pm 6.3); esophagus=129-154 μm (140 \pm 7.5); VL=345-434 μm (377 \pm 26.4); vulva-anus=223-306 μm (253 \pm 24.2); tail=44-54 μm (49 \pm 3.3); tail/V-a=16.6-21.4% (19.3 \pm 1.27); annule=1.3-1.9 μm (1.6 \pm 0.21).

Morphology: Female: Body arcuate when killed by gentle heating. Annules coarse and deeply

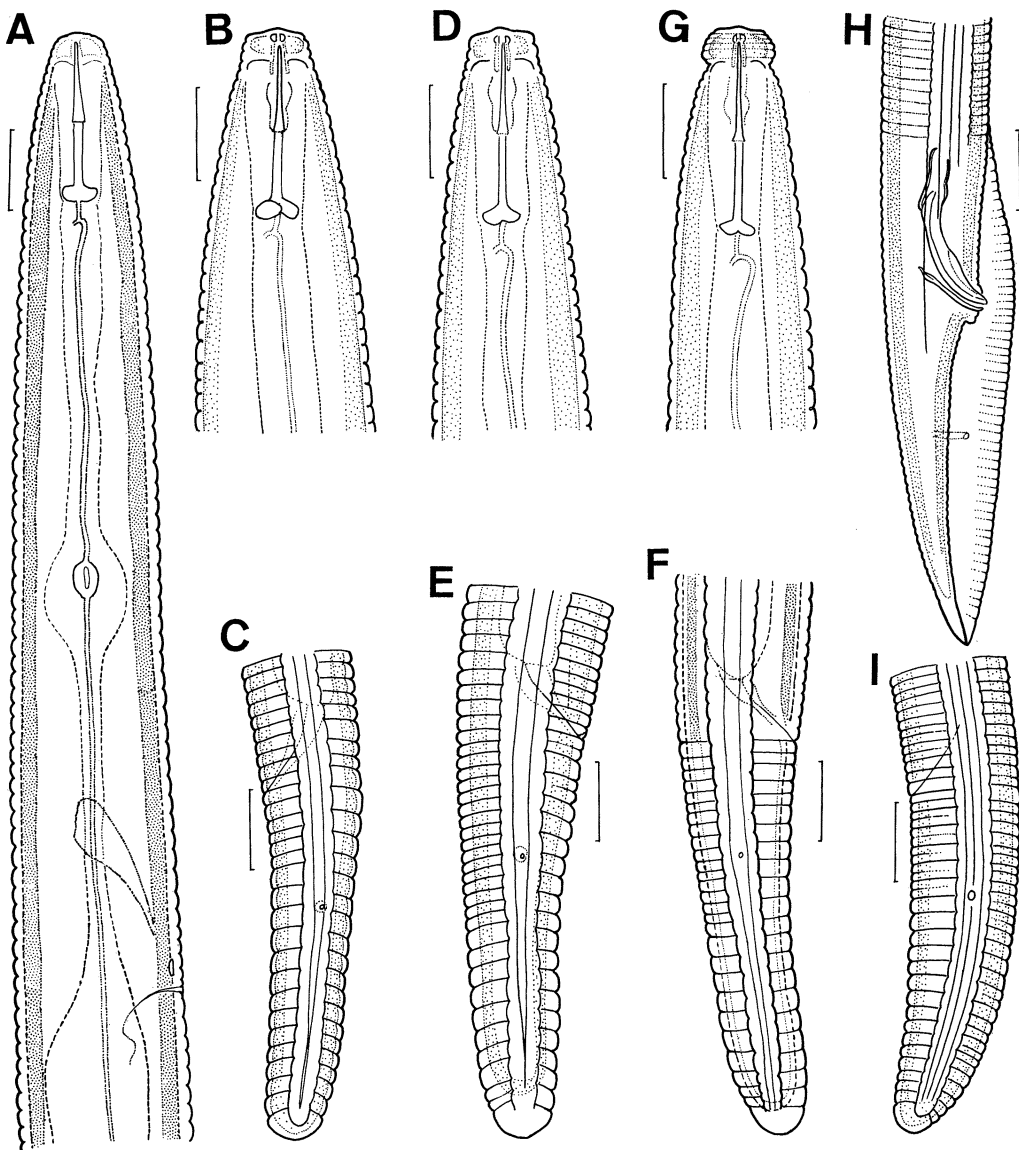


Fig. 1. A-F: *Tylenchorhynchus annulatus* (CASSIDY), females; A, C-F: col. no. 68; B, D: col. no. 5. G-I: *T. maqbooli* nom. nov., col. no. 22; G, I: female; H: male. Scale bars: 10 μ m.

expressed. Lip region slightly offset, with 3 annules (rarely 2 in col. no. 68); labial framework lightly sclerotized. Knobs of spear sloping backward. Number of annules from anterior body end to excretory pore (Rex) 55, 55-61 (59 ± 2.0 ; $n=7$) and 59-62 (61 ± 1.0 ; $n=7$) in col. nos. 5, 40 and 68, respectively. Lateral fields crenate on margins, with 4 incisures. Tail subcylindrical with 19-20 ($n=2$), 19-28 (24 ± 2.8 ; $n=9$) and 21-33 (26 ± 4.7 ; $n=11$) annules in col. nos. 5, 40 and 68, respectively; terminus smooth, hemispherical or subhemispherical.

Male: Not found.

Host plants and localities: Clove tree (*Eugenia caryophyllus* BULLOEK & HARRISON), Bang-

kok (col. no. 5); Maize (*Zea mays* L.), Chiagn Mai (col. no. 40) and Phuraphattabad (Saraburi Province) (col. no. 68).

Remarks: MIZUKUBO & TOIDA⁽¹³⁾ found that a Malaysian population of the *T. annulatus* showed wider variability of the characters than those so far known for this species. Present populations from Thailand show the differences, though overlapping one another, in a-value (31.7-34.5, 25.2-30.0 and 23.0-32.4), c'-value (3.4-3.7, 2.5-3.3 and 2.8-4.0), V-value (56.0-57.1%, 55.6-58.3% and 54.6-56.6%) and tail annules (19-20, 19-28, 21-33) in col. nos. 5, 40 and 68, respectively. Further, the DGO of col. no. 5 does not overlap with those of col. nos. 40 and 68; i.e., 2.0-2.2 μm vs. 3.3-4.0 μm and 2.8-4.0 μm , respectively. Nevertheless, all the ranges in the measurements, including those of the DGO, fit into the ranges in morphometrics taken from Malaysian population. It should be stressed that Thai populations, as well as Malaysian one, often show the inner incisures of lateral fields approaching at a posterior half of the tail (Fig. 1 C & E), since the synonymy of *T. sacchari* SIVAKUMAR & MAHAJAN, 1983 with *T. annulatus* was proposed based on the evidence of variability in the lateral lines of the latter species⁽¹³⁾.

Tylenchrhynchus maqbooli nom. nov.

Syn. *Quinisulcius solani* MAQBOOL, 1982

Syn. *T. solani* (MAQBOOL, 1982) FORTUNER & LUC, 1987

(Fig. 1 G-I)

Measurements (female): Col. no. 22 ($n=1$): L=710 μm ; a=30.6; b=6.0; c=13.5; c'=3.2; V=54.8% MB=52%; spear=20 μm ; m=50%; DGO=2.0 μm ; O=10.0%; EXPORE=106 μm ; esophagus=118 μm ; VL=390 μm ; vulva-anus=268 μm ; tail=53 μm ; tail/V-a=19.7%; annule=1.8 μm .

Measurements (males): Col. no. 22 ($n=2$): L=476-638 μm ; a=32.0-35.3; b=4.5-5.4; c=11.3-14.3; c'=3.6-4.1; T=61% ($n=1$); MB=50.0-53.0%; spear=18.5-19.5 μm ; m=52.5-56.5%; DGO=1.6-2.0 μm ; O=8.7-10.2%; EXPORE=83-95 μm ; esophagus=107-119 μm ; tail=42.2-44.8 μm ; annule=1.2-1.5 μm ; spicule=18.8-20.5 μm ; gubernaculum=6.4-9.9 μm .

Morphology: Female: Body assuming C shape when killed by gentle heating. Lip region hemispherical, offset by constriction, with 6 annules. Cephalic framework lightly sclerotized. Spear knobs posteriorly sloping. Lateral fields with 5 incisures, crenate on margins and areolated on tail region. Tail conoid with 28 annules ventrally; terminus subhemispherical and smooth.

Male: Similar to female. Gubernaculum with straight proximal end.

Host plant and locality: Papaya (*Carica papaya* L.), Nakhon Ratchasima.

Remarks: This population will belong to the *Quinisulcius* SIDDIQI, 1971, which has recently been synonymized with *Tylenchorhynchus* (5). By having 5 lateral field incisures, offset lip region, conoid tail with smooth and bluntly rounded terminus, this population differs from all other *Tylenchorhynchus* (sensu FORTUNER & LUC, 1987 (5)) except for *Quinisulcius indicus* LUQMAN & KHAN, 1986 (10), *T. acutoides* THORNE & MALEK, 1968 (23), *T. capitatus* ALLEN, 1955 (1), *T. curvus* WILLIAMS, 1960 (24), *T. obregonus* (KNOBLOCH & LAUGHLIN, 1972) (9), *T. paracti* (RAY & DAS, 1983) (17), *T. solani* (MAQBOOL, 1982) (12) (syn. of *T. capitatus* according to SIDDIQI (19) and FORTUNER & LUC (5)). Present population distinguished from *T. obregonus* and *T. acutoides* by the large number of lip annules (6 vs. 4-5) and from *T. capitatus* and *T. paracti* by the smaller number of lip annules (6 vs. 7-8). *Quinisulcius indicus* and *T. curvus* have shorter spear (15-18 μm and 17 μm , respectively). Hence, this population can be identified as *T. solani*

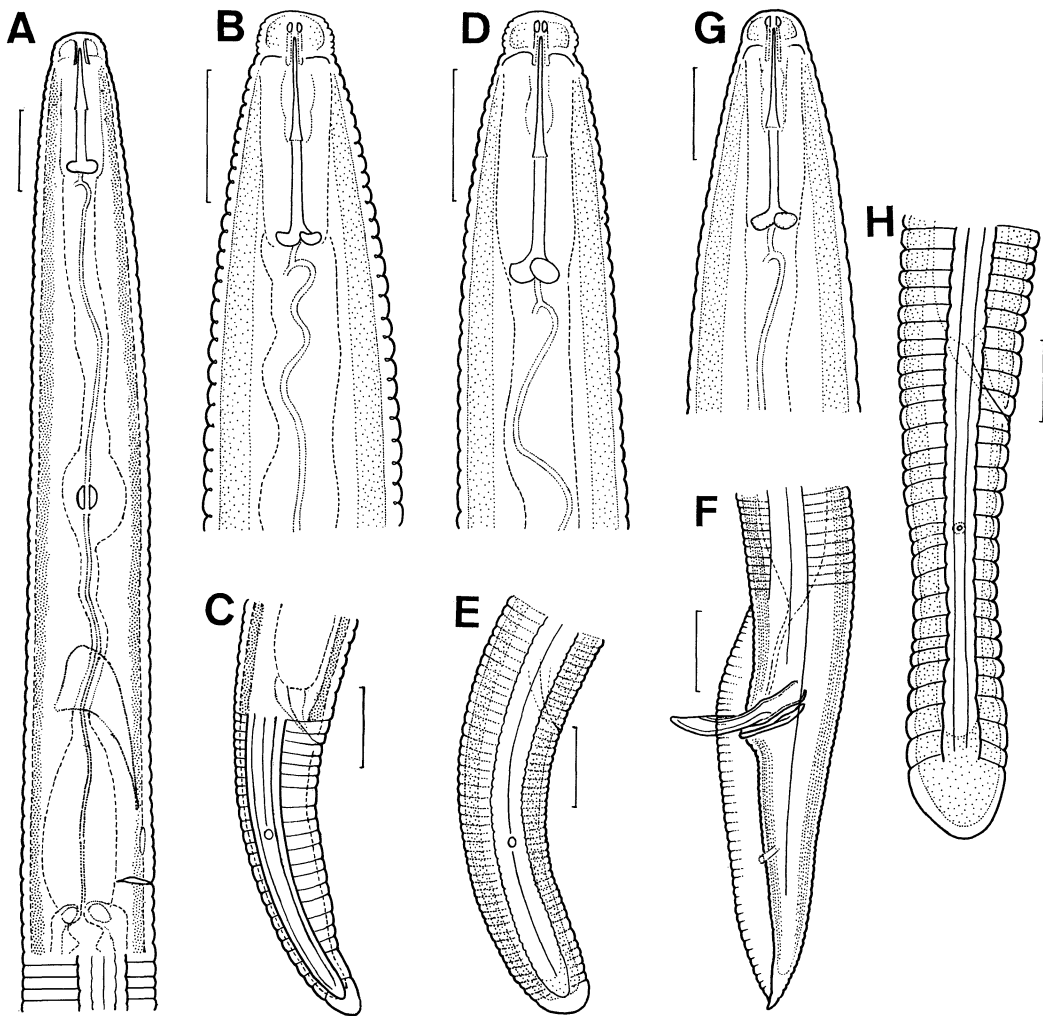


Fig. 2. A-C: *Tylenchorhynchus curvus* WILLIAMS, 1960, female, col. no. 68. D-F: *T. divittatus* SIDDIQI, col. no. 12; D, E: female; F: male. G-H: *T. leviterminalis* SIDDIQI, MUKHERJEE & DASGUPTA, female, col. no. 6. Scale bars: 10 μ m.

(MAQBOOL, 1982) FORTUNER & LUC, 1987. The latter name, however, is a junior secondary homonym of *T. solani* GUPTA & UMA, 1981. By the following reason, we consider *T. solani* (MAQBOOL, 1982) as distinct species and *T. maqbooli* nom. nov. is designated for this species. *Tylenchorhynchus maqbooli* nom. nov. in the original description (11) lacks male, while our population has males. This difference may not be important, since *T. maqbooli* was described on the 6 females basis. Rather, it is important that male of our population has straight proximal end of gubernaculum in contrast with *T. capitatus*, which has dorsally curved proximal end in this structure. This is the first record of *T. maqbooli* in Thailand and outside Pakistan.

Tylenchorhynchus curvus WILLIAMS, 1960

(Fig. 2 A-C)

Measurements (females): Col. no. 68 (n=6): L=442-606 μm (547 ± 56.9); a=25.7-31.8 (28.5 ± 2.37); b=5.0-5.5 (5.3 ± 0.18); c=15.4-18.9 (17.3 ± 1.19); c'=2.3-2.6 (2.5 ± 0.10); V=55.3-57.2% (56.4 ± 0.70); MB=49.2-55.3% (51.0 ± 2.22); spear=13.5-15 μm (14.6 ± 0.60); m=47.1-52.6% (49.8 ± 1.82); DGO=1.2-1.7 μm (1.4 ± 0.2); O=7.9-11.4% (9.6 ± 1.5); EXPORE=83-106 μm (99 ± 9.1); esophagus=82-113 μm (103 ± 10.5); VL=250-345 μm (309 ± 33.1); vulva-anus=164-229 μm (207 ± 22.9); tail=29-34 μm (32 ± 1.9); tail/V-a=14.0-17.6% (15.4 ± 1.30); annule=1.0-1.4 μm (1.3 ± 0.17).

Morphology: Female: Body arcuate or open C-shaped when killed by gentle heating. Lip region rounded, offset but not constricted, with 5-6 annules; cephalic framework moderately sclerotized. Spear knobs sloping backward or flattened anteriorly. Laterrall fields about 1/3 of body diameter, with 5 equally spaced incisures. Tail conoid with 15-18 annules, terminus bluntly pointed and smooth.

Male: Not found.

Host plant and locality: Maize (*Zea mays* L.), Phuraphattabad (Saraburi Province) (col. no. 68).

Remarks: This population resembles following member of the *Tylenchorhynchus* (sensu FORTUNER & LUC, 1987 (5)), which possess offset lip region, 5 lateral field incisures, conoid tail with smooth and bluntly pointed terminus: *Quinisulcius indicus* LUQMAN & KHAN, 1986 (10), *T. acutoides* THORNE & MALEK, 1968 (23), *T. capitatus* ALLEN, 1955 (1), *T. curvus* WILLIAMS, 1960 (24), *T. obregonus* (KNOBLOCH & LAUGHLIN, 1972) (9), *T. paracti* (RAY & DAS, 1983) (17), and *T. maqbooli* (= *T. solani* (MAQBOOL, 1982) (12)). *T. obregonus* comes close to our specimens with respect to spear length, but the species has more distanced DGO (3.2 μm), large number of tail annule (19-25) and presence of males. *Quinisulcius indicus*, *T. acutoides*, *T. capitatus*, *T. curvus* and *T. maqbooli* are excluded from our population as they have spear of 16 μm or longer. Nevertheless, present population comes closest to *T. curvus* when the over all similarity is taken into account: there exist only one differences in the spear; i.e., *T. curvus* has 17 μm -long-spear, present population has 13.5-15 μm -long-spear. Hence, we consider this population as a variation of *T. curvus*.

Tylenchorhynchus divittatus SIDDIQI, 1961

(Fig. 2 D-F)

Measurements (females): Col. no. 12 (n=1): L=494 μm ; a=30.1; b=5.0; c=14.0; c'=2.9; V=55.2%; MB=50.0%; spear=17.2 μm ; m=51.2%; DGO=1.2 μm ; O=7.0%; EXPORE=78 μm ; esophagus=99 μm ; VL=273 μm ; vulva-anus=186 μm ; tail=35 μm ; tail/V-a=18.9%; annule=1.0 μm .

Col. no. 26 (n=2): L=475 μm ; a=25.8-30.0; b=4.6-4.8; c=14.1-14.5; c'=2.8-3.0; V=55.2-58.5%; MB=46.8-48.1%; spear=17.5-17.6 μm ; m=52.8-54.5%; DGO=2.0-2.3 μm ; O=11.4-13.2%; EXPORE=75-78 μm ; esophagus=99-103 μm ; VL=262-278 μm ; vulva-annus=164-180 μm ; tail=33-34 μm ; tail/V-a=18.2-20.6%; annule=1.1 μm .

Measurements (males): Col. no. 26 (n=2): L=425-545 μm ; a=30.7-31.0; b=4.3-5.0; c=15.3-15.8; c'=3.0-3.2; MB=47.7-48.0%; spear=17.8-18.0 μm ; m=51.9-53.3%; DGO=2.4-2.6 μm ; O=

13.3-14.8%; EXPORE=75-76 μm ; esophagus=100-109 μm ; tail=28-34 μm ; annule=1.1-1.2 μm ; spicule=17-19 μm ; gubernaculum=9-9.5 μm .

Morphology: Female: Body assuming single spiral when killed by gentle heating. Lip region rounded, constricted from neck, with 5-6 annuli; cephalic framework lightly sclerotized. Anterior margins of spear knobs sloping posteriorly. Lateral field with 3 incisures, weakly crenate on margins. Tail cylindrical with 24-27 annules (col. no. 26) or 34 annules (col. no. 12); terminus smooth and hemispherical.

Male: Similar to female. Basal alae not envelop tail terminus. Gubernaculum straight at proximal end.

Host plants and localities: Mulberry (*Morus alba* L.), Bangkok (col. no. 12); Jasmine (*Jasminum sambac* AIT.), Nakhon Ratchasima (col. no. 26)

Remarks: By having distinctly offset lip region and 3 incisures of lateral fields, present populations are separated from all the *Tylenchorhynchus* species except for *T. divittatus* SIDDIQI, 1961 (18), *T. pruni* GUPTA & UMA, 1981 (6), *T. rayi* FORTUNER & LUC, 1987(5) and *T. trilineatus* TIMM, 1963 (23). The later 3 species, however, differ from present populations in the longer spear (21-26 μm). Present populations differ from original description (18) by the body length (475-494 μm vs. 550-720 μm), which is considered intra-specific variation.

Tylenchorhynchus leviterminalis SIDDIQI, MUKHERJEE & DASGUPTA, 1982

(Fig. 2 G-H)

Measurements (females): Col. no.6 (n=6): L=650-782 μm (696 ± 47.3); a=26.2-30.1 (28.0 ± 1.30); b=5.0-6.0 (5.3 ± 0.36); c=13.5-15.9 (14.7 ± 0.99); c'=3.1-3.8 (3.3 ± 0.26); V=52.7-55.8% (54.3 ± 1.16); MB=47.9-51.3% (50.1 ± 1.32); spear=20.5-21 μm (20.9 ± 0.30); m=46.2-50.0% (48.1 ± 2.72); DGO=3.0-3.5 (3.2 ± 0.13); EXPORE=95-106 μm (100 ± 4.0); esophagus=124-135 μm (131 ± 4.4); VL=361-412 μm (378 ± 18.3); vulva-anus=240-318 μm (271 ± 27.5); tail=42-51 μm (48 ± 3.4); tail/V-a=16.1-20.7% (17.7 ± 1.67); annule=1.7-1.9 μm (1.8 ± 0.12).

Morphology: Female: Lip region hemispherical, small and smooth, continuous to body contour; cephalic framework lightly sclerotized. Spear knobs laterally directed. Lateral field about 1/4 of body width, with equally distanced 4 incisures. Spermatheca filled with spermatozoa. Tail clavate with 17-25 (19 ± 3.1 : n=6) annules; terminus hemispherical and smooth.

Male: Not found.

Host plant and locality: *Lagerstroemia speciosa* (L.) PERS., Bangkok (col. no. 6).

Remarks: Present population well consistent with the original description of the species (20) except in the slightly longer spear (20.5-21 μm vs. 17-19 μm) and absence of males. The difference in spear length considered here as intra-specific variations. Males may present in this population because the females' spermathecae often filled with spermatozoa.

LITERATURE CITED

- 1) ALLEN, M.W. (1955) A review of the nematode genus *Tylenchorhynchus*. Univ. Calif. Publ. Zool. 61, 129-165.
- 2) BOONDUANG, A. & PLIANSINCHAI, U. (1980) Identification of plant parasitic nematodes of Thailand. A systematic study of plant parasitic nematodes of kenaf in Thailand. Nematol. Sect. Tech. Bull. (Pl. Pathol. Div., Dept. Agric., Min. Agr. Co-op., Bangkok, Thailand), No. 3, 45 pp.

- 3) BOONDUNANG, A. & RATANAPRAPA, D. (1977) Identification of plant parasitic nematodes of Thailand. A systematic study of *Tylenchorhynchus* in Thailand. Nematol. Sec. Tech. Bull. (Pl. Pathol. Div., Dept. Agric., Min. Agric. Co-op., Bangkok, Thailand), No. 1, 27 pp.
- 4) CHUNRAM, C. (1972) A list of plant parasitic nematodes in Thailand. Pl. Prot. Serv. Tech. Bull. (Pl. Indust. Div., Min. Agric., Bangkok, Thailand & UNDP 9/FAO THA 68/526), No. 1, 44 pp.
- 5) FORTUNER, R. & LUC, M. (1987) A reappraisal of Tylenchina (Nemata). 6. The family Belonolaimidae WHITEHEAD, 1960. Revue Nématol. **10**, 183-202.
- 6) GUPTA, N.K. & UMA (1981) Description of two new species of the genus *Tylenchorhynchus* COBB, 1913 - family Tylenchorhynchidae (ELIAVA, 1964), GOLDEN, 1971 - from India. Helminthologia **18**, 53-59.
- 7) HOOPER, D.J. (1978) The identification and biology of stunt nematodes (Tylenchorhynchidae) especially those in Western Europe. In: *Spiral and stunt nematodes*, Association of Applied Biologists, Nematology Group, Rothamsted, England, 1-75.
- 8) KEEREewan, S. & LEEPRASERT, C. (1975) Distribution of plant parasitic nematodes of mulberry in Thailand. Pl. Prot. Serv. Tech. Bull. (Nematol. Res. Branch, Dept. Agric., Min. Agric. Co-op., Bangkok, Thailand & UNDP 9/FAO THA 68/526), No. 28, 18 pp.
- 9) KNOBLOCH, N.A. & LAUGHLIN, C.W. (1973) A collection of plant parasitic nematodes (Nematoda) from Mexico with descriptions of three new species. Nematologica **19**, 205-217.
- 10) LUQMAN, M. & KHAN, S.H. (1985 publ. 1986) Three new nematode species attacking fruit trees in India. Indian J. Nematol. **15**, 202-208.
- 11) MAHAJAN, R. (1988 publ. 1989) A conspectus of the genus *Tylenchorhynchus* COBB, 1913 (Nematoda: Tylenchorhynchinae). Indian J. Nematol. **18**, 199-206.
- 12) MAQBOOL, M.A. (1982) Description of *Quinisulcius solani* n. sp. (Nematoda: Tylenchidae) with a key to the species and data on *Scutylenchus koreanus* from Pakistan. J. Nematol. **14**, 221-225.
- 13) MIZUKUBO, T. & TOIDA, Y. (1991) Morphological variations in a Malaysian population of *Tylenchorhynchus annulatus annulatus* n. rank (Nemata: Belonolaimidae). Appl. Entomol. Zool. **26**, 406-409.
- 14) MIZUKUBO, T., TOIDA, Y. & KEEREewan, S. (1992) A survey of the nematodes attacking crops in Thailand. I. Genus *Helicotylenchus* STEINER, 1945. Jpn. J. Nematol. **22**, 26-36.
- 15) PLIANSINCHAI, U. & BOONDUNANG, A. (1978) Identification of plant parasitic nematodes of Thailand. A systematic study of the plant parasitic nematodes of black pepper in Thailand. Nematol. Sect. Tech. Bull. (Pl. Pathol. Div., Dept. Agric., Min. Agric. Co-op., Bangkok, Thailand), No. 2, 52 pp.
- 16) PLIANSINCHAI, U. & BOONDUNANG, A. (1986) Identification of plant parasitic nematodes of Thailand. A systematic study of the plant parasitic nematodes of sugarcane in Thailand. Nematol. Sect. Tech. Bull. (Pl. Pathol. Microbiol. Div., Dept. Agric., Min. Agric. Co-op., Bangkok, Thailand), No. 5, 75 pp.
- 17) RAY, S. & DAS, S. N. (1983) Three new and five nominal species in the family Tylenchorhynchidae (Tylenchoidea: Nematoda) from Orissa, India. Indian J. Nematol. **13**, 16-25.
- 18) SIDDIQI, M.R. (1961) Studies on *Tylenchorhynchus* spp. (Nematoda: Tylenchida) from India. Z. Parasitenk. **21**, 46-64.
- 19) SIDDIQI, M.R. (1986) *Tylenchida parasites of plants and insects*. Commonwealth Agricultural Bureaux. Slough, U.K. 645 pp.
- 20) SIDDIQI, M.R., MUKHERJEE, B. & DASGUPTA, M.K. (1982) *Tylenchorhynchus microconus* n. sp., *T. crassicaudatus leviterminalis* n. subsp. and the *T. coffeae* SIDDIQI & BASIR, 1959 (Nematoda: Tylenchida). Syst. Parasitol. **4**, 257-262.
- 21) TARJAN, A.C. (1973) A Synopsis of the genera and species in the Tylenchorhynchinae (Tylenchoidea, Nematoda). Proc. helminthol. Soc. Wash. **40**, 123-144.
- 22) THORNE, G. & MALEK, R.B. (1968) Nematodes of the northern great plains. Part I. Tylenchida. (Nematoda: Secernentea). S. Dak. Agr. Expt. Sta. Tech. Bull. **31**, 1-111.
- 23) TIMM, R.W. (1963) *Tylenchorhynchus trilineatus* n. sp. from west Pakistan, with notes on *T. martini*.

Nematologica 9, 262-266.

- 24) WILLIAMS, J.R. (1960) Study on the nematode soil fauna of sugar cane fields in Mauritius. 4. Tylenchoidea (partim). Occ. Paper Sug. Ind. Res. Inst. Mauritius 4, 30 pp., 2 pls.

Accepted for publication: February 15, 1993

和文摘要

タイ国における作物加害線虫の調査 II. *Tylenchorhynchus* 属

水久保隆之・樋田 幸夫・KEEREewan, S.

タイ国の作物圃場から検出されたイシユクセンチュウ (*Tylenchorhynchus* 属) の5種: *T. annulatus*, *T. curvus*, *T. divittatus*, *T. leviterminalis* 及び *T. maqbooli* (新名) の計測値を示し、形態の記載と図示を行った。*T. leviterminalis* と *T. maqbooli* はタイ国からの新記録種であった。